



Adaptive and Simultaneous Strategies in Smallholder Household Economics: A 2SLS Approach to Labor and Consumption Optimization

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Consumption.

This study examines smallholder farmer households optimize labor, income, and consumption through adaptive and simultaneous strategies. Using data from 227 smallholder farmer household households in Indonesia, a simultaneous equations model estimated with Two-Stage Least Squares (2SLS) was applied. The analysis result shows the men's workload in farm is affected significantly by the time from other sector and the income. In the other hand, women's workload in non-farm sector is increase by the time the amount of the number of dependents and economic intensive. The total overall income is depended by the contribution of work in the farm and non-farm sector. Besides, the food consumption expenditure is affected by the income, while the non-food consumption expenditure is affected by income and the amount school-child in a family. This finding emphasized that smallholder farmer household applied adaptive and simultaneous strategy in maintaining the farmer and outcome to face the economic limitation rationally.

1. Introduction

Wellbeing imbalance and structural poverty remain a core challenge faced by smallholder farmers. This group are generally has farm land and it depends on daily wage that stands on vulnerable position both of socially and economy. The data in 2022 showed 13,31% from the total of national poor population came from smallholder farmers group (Ministry of Finance of Indonesia, 2025). This condition reflects the main problems in rural economy structure and the weakness

in distribution within the agricultural development sector (Abduh, 2023).

Farm sector has strategic role in the middle of national economic development especially in rural areas. As the main foodstuff supply, this sector also absorb a workers in a big amount through any kind of direct activity or the other supporting economic activities. The smallholder farmer's wellbeing as the main factor in this sector does not show significant improvement yet (Anggara & Alfahma, 2024). Rural area in Indonesia

reflects those realistic with more than 40% workers are depend on farm sector and the majority are smallholder farmers. One of the issues related to smallholder farmers Indonesia and the other countries are the highest number of jobless around young labor (Ardyanti et al., 2023). Facing the economic pressure, smallholder farmer household in this rural area develop an economic behavior through work time management, diversification source of income, and the efficiency of household expenditure.

Timing is a scarce resource which cannot be accumulated since it needs an efficient managing of household. A prior study gives an emphasized the importance of time management to determine household wellbeing. In this selected theory framework, a household is considered as the agent of economic decision maker that has a goal to reach optimal wellbeing through the consideration benefit and general charges. Smallholder farmer household will have a tendency to allocate workload in activity that has a value to get stable income. Income diversification strategy appear as the rational response towards unstable economic. Ellis (2000), stated that rural household are generally involved in any economic activities, both inside or out the major agricultural, such as freelance, informal service, or utilization of local source in subsistence. This strategy is adaptive because it is able to reduce the failure risk on single income. The simultaneous strategy is done along with the main activity to strengthen the economy resilience of household.

Previous research about rural economic household is generally focused on the farmer land owner, while the study describes smallholder farmer in economic household terms of model which simultaneous is still limited (Priyanti et al., 2007). Smallholder farmer have a different economy characteristic due to the access through the productive resources, reliant of daily wages, also the vulnerability of climate change. This imbalance structural makes the smallholder farmer often marginalized in academic discourse within the formulation of rural development policies (Pratama & Nanang, 2025).

This research is aimed to analyze the optimization strategy of farmer's workload through the adaptive and simultaneous approach. Adaptive strategy is seen through household ability to change work pattern and expenses to suit toward economic changes, while the simultaneous strategy will emphasize to the dynamic interaction between the economic decision such as work timing, income, and foodstuff which influence each other.

By using quantitative approach to measure the relation between variable and qualitative approach to delve social dynamic and household strategies (Sumarno, Oktaviani, & Aditya, 2022). Both combinations give a comprehensive understanding about the economic dynamic of smallholder farmer household. This result of the research expected to become an input regarding to the formulating policies for more inclusive and responsive rural development toward real needs of vulnerable society, mainly for social security aspect, productive job creation, and enhancement access toward economic resources (Herdiana, 2022).

2. Materials and Method

This research is held in Bojonegoro known as one of the national food barns and rice production centers in East Java Province, Indonesia. Rice is a staple food for most Indonesians. The research location of Selorejo Village, Baureno District, was purposively selected because most of the population are smallholder farmers without landowners, dependent on daily wages from the agricultural sector, and is a rice production area. Purposive sampling was conducted with the criteria of the sample unit being farm laborers with the main income from daily agricultural workers, obtained as many as 227 smallholder farmer households.

This study develops an analytical approach that combines adaptive and simultaneous concepts through the structure of household members' workloads and their linkages to income sources and consumption. The developed model is based on the conceptual framework presented in Figures 1 and 2, emphasizing the relationship between male and female farmers' workloads across various sectors (on-farm, off-farm, and non-farm), as well as household demographic and economic factors. This approach allows for the identification of complex and layered pathways of influence, reflecting how smallholder households respond to simultaneous economic and social pressures. The operational definitions of the variables presented in Table 1, explaining the relationships between concepts, and the following smallholder household economic model serve as an important foundation for analyzing optimization strategies based on the local context and household structure.

The Conceptual framework of the study stated over identified, so this aspect fill the requirement to be estimated using 2SLS approach. This model is used to reveal the smallholder farmer's worker optimization strategy that runs adaptively and simultaneously in the rural economy dynamics.

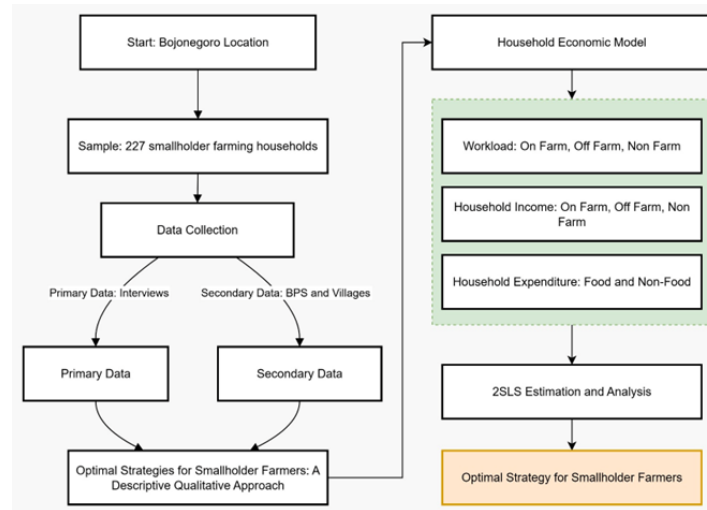


Figure 1: Conceptual Framework of the Study Showing Interactions among Workload and Optimization Strategy of Economic Household.

Table 1: Definition of Operational.

Variable	Code	Variable	Code	Sources
Workload of smallholder men farmer on farm	A	Workload of smallholder men farmer off farm	A1	(Husin & Sari, 2011)
		Workload of smallholder men farmer Non-farm	A2	
		Total income of households	A3	
Workload of smallholder women farmer on farm	B	Workload of smallholder women farmer off-farm	B1	(Puspitasari, Phariyanto, & Yanti, 2019)
		Workload of smallholder women farmer Non- farm	B2	
		Total income of households	B3	
Workload of smallholder men farmer off farm	C	Workload of smallholder men farmer on farm	C1	(Husin & Sari, 2011)
		Workload of smallholder men farmer Non-farm	C2	
		Household income off-farm	C3	
Workload of smallholder women farmer off-farm	D	Workload of smallholder women farmer on farm	D1	(Prawirasari & Ridho, 2022)
		Household income off-farm	D2	
		Amount of family member	D3	
Workload of smallholder men farmer Non-farm	E	Household income non-farm	E1	(Husin & Sari, 2011)
		Workload of smallholder men farmer off farm	E2	
		Amount of children attend to school	E3	
Workload of smallholder women farmer Non- farm	F	Total of household expenditure	F1	(Husin & Sari, 2011)
		Workload of smallholder women farmer on farm	F2	
		Amount of children attend to school	F3	
Food consumption expenditure	G	Total income of households	G1	(Darmawati & Arka, 2024)
		Amount of family member	G2	
Non-food Consumption household	H	Total income of households	H1	(Wahyuni et al., 2025)
		Amount of children attend to school	H2	

3. Result and Discussion

3.1. Result

The Two-Stage Least Squares (2SLS) estimation results, as summarized in Table 2, reveal significant insights into the labor allocation and consumption patterns of smallholder farmer households. Across the eight estimated models, most explanatory variables show statistically significant effects, with R-squared values ranging from 64.85% to 86.14%, indicating a strong explanatory power. The models confirm that male and female farmers allocate labor differently based on sector, income, household structure, and seasonal dynamics. For example, men's on-farm workload is

negatively influenced by their engagement in off-farm and non-farm sectors, while off-farm income positively motivates their off-farm labor. In contrast, women's workload on the farm is significantly reduced by involvement in non-farm activities and is less responsive to household income changes, highlighting the influence of non-economic and domestic factors. Additionally, both food and non-food consumption are positively affected by total household income, supporting classical consumption theories, while the number of school-aged children significantly increases non-food expenditures. These findings emphasize the complex, gendered, and adaptive strategies of rural households in managing labor and consumption amid limited resources and shifting economic opportunities.

Table 2: The Estimating Result Smallholder Farmer Workload, Food and Non Food Consumption Household.

No.	Variable	Coefficient	t-statistic	Prob.	R ²
1	A				80.88
	Costanta	120.0024	31.56786	0.0000	
	A1	-0.928304	-16.7112	0.0000**	
	A2	-0.828927	-14.8155	0.0000**	
2	B				82.16
	Costanta	72.65124	32.56494	0.0000	
	B1	-0.642707	-15.5849	0.0000**	
	B2	-0.295754	-7.79017	0.0000**	
3	C				83.33
	Costanta	46.84667	11.90994	0.0000	
	C1	-0.327345	-11.7231	0.0000**	
	C2	4.89E-06	16.6097	0.0000**	
4	D				86.14
	Costanta	31.58927	8.848423	0.0000	
	D1	-0.587464	-16.3885	0.0000**	
	D2	3.24E-06	10.67718	0.0000**	
5	E				64.85
	Costanta	51.57109	18.08058	0.0000	
	E1	-4.54E-07	-1.17817	0.2400	
	E2	-0.393269	-15.6780	0.0000**	
6	F				77.04
	Costanta	22.29736	5.442076	0.0000	
	F1	-0.557073	-16.1999	0.0000**	
	F2	3.207777	6.067002	0.0000**	
7.	G				78.73
	Costanta	1398918	4.272214	0.0000	
	G1	0.442511	27.21263	0.0000**	
	G2	-29127.10	-0.35777	0.7208	
8.	H				66.38
	Costanta	736014.0	2.036288	0,0429	
	H1	0.383860	19.01861	0.0000**	
	H2	210302.4	2.024807	0,0441*	

Description: **, * shows significant at 5%, and 1% respectively

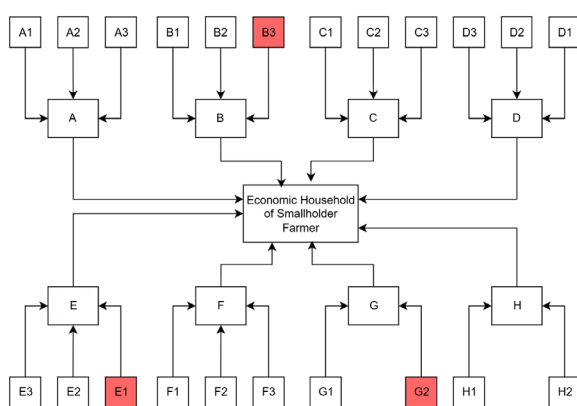


Figure 2: Economics of Smallholder Farmer's Household Model.

Description: red box shows the variable not significant

4. Discussion

The results of the Two-Stage Least Squares (2SLS) estimation reveal that smallholder farmers' labor allocation patterns are strongly influenced by economic

incentives, seasonal agricultural cycles, and household characteristics. In the case of men, higher household income is positively associated with increased time allocated to the farm sector, indicating that farming continues to play a central role in the rural household economy (Wangmo, Dorji, & Dorji, 2024). Despite the availability of better-paying opportunities in the off-farm or non-farm sectors, men do not entirely abandon farming. Instead, they strategically maintain agricultural engagement due to its perceived long-term stability, access to natural resources, and embedded social value (Srinivas & Giridhar, 2022). This supports Becker's time allocation theory and Ellis's livelihood framework, where households pursue mixed strategies to balance income, risk, and identity (Ellis, 2000).

Men's workload models demonstrate a clear substitution between time spent on-farm and in other sectors. An increase in farm labor hours significantly reduces time spent in off-farm or non-farm work, and vice

versa (Dijkstra, 2021). However, income from off-farm activities acts as a strong pull factor, motivating men to allocate more time to these sectors when the return is high (Barrett, Reardon, & Webb, 2001). This dynamic suggests that men's labor decisions are shaped by immediate income needs and the relative opportunity cost of time. During peak agricultural periods such as planting and harvesting, most men focus on farming, while in lean seasons, they shift to construction or other informal labor. This temporal flexibility allows them to maximize income while remaining embedded in their agrarian livelihoods (Adha, 2019).

For women, the relationship between labor allocation and economic variables is more nuanced. Increased workload in off-farm or non-farm sectors significantly reduces their time on-farm, reflecting the trade-off due to time and energy constraints (Oyinbo et al., 2019). However, household income does not significantly affect women's decision to remain engaged in farming, suggesting that non-monetary factors—such as land inheritance, cultural expectations, and domestic obligations—also play a vital role (Adefila et al., 2024). In many rural communities, socio-cultural norms assign women the dual responsibility of economic contribution and domestic care, which constrains their mobility and reduces their ability to pursue higher-income but more time-consuming opportunities (Hanan, 2022). At the same time, these same norms enable adaptive strategies by legitimizing women's involvement in flexible or home-based work, such as food processing, petty trade, or piece-rate labor. This duality shows that women's choices are not purely individual or economic but embedded in the cultural frameworks that define acceptable roles and responsibilities within the household (Musianto, 2002). Women often choose flexible, home-based work such as onion peeling, food preparation, or small-scale vending to simultaneously manage household responsibilities and contribute economically (Manyang, Fauzi, & Kadir, 2022).

These choices reflect a layered strategy that accommodates both paid labor and unpaid domestic work. Yet, this arrangement emerges within a broader socio-cultural environment where traditional gender roles restrict women's time, decision-making power, and access to productive resources (Hanan, 2022). Women's adaptive strategies are therefore shaped by constraint as much as by agency: while they creatively combine agricultural, informal, and domestic roles to sustain household livelihoods, their ability to expand into higher-return sectors is limited by norms that

prioritize caregiving and household duties (Tian et al., 2015). Nevertheless, these same norms allow women to adopt multi-tasking livelihood strategies—working on farms in the morning, undertaking small-scale vending in the afternoon, and continuing domestic labor in the evening—without fully stepping outside accepted cultural boundaries. This demonstrates how socio-cultural structures both limit and facilitate women's adaptive capacity in navigating household economic pressures (Ferrant, Pesando, & Nowacka, 2014).

Women's off-farm labor is also positively influenced by the number of household members and off-farm income (Susilowati, 2017). A larger household provides more labor flexibility, allowing some members to engage in income-generating activities while others handle domestic duties. Moreover, higher income from off-farm sources encourages further participation, indicating a reinforcing loop of economic diversification (Utami, 2014). Still, women's labor decisions are heavily constrained by traditional gender roles that prioritize domestic responsibilities over income generation (ILO, 2018). Despite these challenges, smallholder women farmers in Indonesia exhibit high adaptability by dividing their time throughout the day—working on farms in the morning and engaging in off-farm tasks in the afternoon—often without complete role separation (Khoiriya & Susilowati, 2022).

The analysis further shows that the presence of school-aged children significantly increases men's and women's involvement in non-farm work (Wahyuni, 2025). The financial burden of education, including tuition, transportation, and supplies, compels household members to seek additional income. However, income from the non-farm sector does not always influence labor allocation, particularly for men (Mizik et al., 2025). This is likely due to the informal and unstable nature of non-farm employment, which lacks sufficient incentives for long-term commitment. Thus, while non-farm activities serve as a fallback strategy during agricultural downtimes, they are not consistently reliable as primary income sources (Ariani, Noviar, & Ertika, 2024).

In terms of consumption, household income positively and significantly affects both food and non-food consumption. The relationship supports Engel's Law and Keynes' marginal propensity to consume, suggesting that income growth is first allocated to basic needs such as food, and subsequently to non-food expenditures like education and transportation (Sinambela, Gayatri, & Mukson, 2025). The number of children attending school also contributes to increased non-food consumption,

reflecting the household's prioritization of education as a long-term investment (Tilak, 2002). However, larger family size does not necessarily lead to higher food consumption, possibly due to economies of scale in household spending and collective consumption behavior (Aminah, Lubis, & Susanto, 2015).

Nevertheless, this study has certain limitations. The use of cross-sectional data provides only a snapshot of household economic behavior and cannot capture seasonal variations in labor allocation, income generation, and consumption that are highly relevant in agrarian settings, suggesting that future longitudinal or panel studies are needed to track adaptive strategies over time. In addition, the reliance on self-reported workload and expenditure measures may introduce recall errors or social desirability bias, particularly for women whose economic contributions are often intertwined with caregiving and other unpaid domestic responsibilities, making their work difficult to quantify precisely. The measurement of non-food consumption is also limited, as it focuses mainly on quantifiable expenditures and does not fully reflect culturally significant obligations such as healthcare costs, ceremonies, or community-based reciprocity, which can substantially influence household decision-making. Finally, although the 2SLS method helps mitigate endogeneity, the model may still be affected by unobserved heterogeneity and omitted variables—such as access to social networks, land tenure security, and local institutional support—that are not captured in the dataset but remain important determinants of household economic behavior.

In conclusion, smallholder farmer households demonstrate complex and dynamic labor allocation and consumption behavior in response to economic, seasonal, and socio-cultural pressures. The use of 2SLS analysis effectively captures the endogenous relationships between income, workload, and consumption, providing robust evidence of simultaneous decision-making processes. Gender roles, household composition, and flexibility in labor allocation all play critical roles in shaping livelihood strategies. These findings underscore the need for policies that support integrated rural development, recognize gendered labor burdens, and enhance the resilience of smallholder households through access to education, infrastructure, and diversified income opportunities.

5. Conclusion

Various dynamics revealed in this research shows the

smallholder farmer household able to arrange economic decision making pattern adaptively and simultaneously. Based on workload management across sector and consumption management considers to the income condition and family needs. They show the not only the flexible response but also the relation between for each economic household component. This strategy applies the adaptive mechanism in dealing with the economic limitations. These also indicate how every decision run simultaneously one and other and influence each other. In the other hand, workforce allocation, income, and consumption do not run by itself, but it relates each other; suit to the climate change, social aspect, also domestic needs. This pattern reflects the way of thinking rationally managing the limit resources for the sustainability the daily live which has been focused on the background of this study.

5.1. Conflict of Interest

The authors declare that there is no conflict of interest.

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